



## PHYTOCHEMICAL & PHARMACOLOGICAL ACTIVITY OF WORLD FAMOUS DRY FRUIT (PHOENIX DACTYLIFERA)

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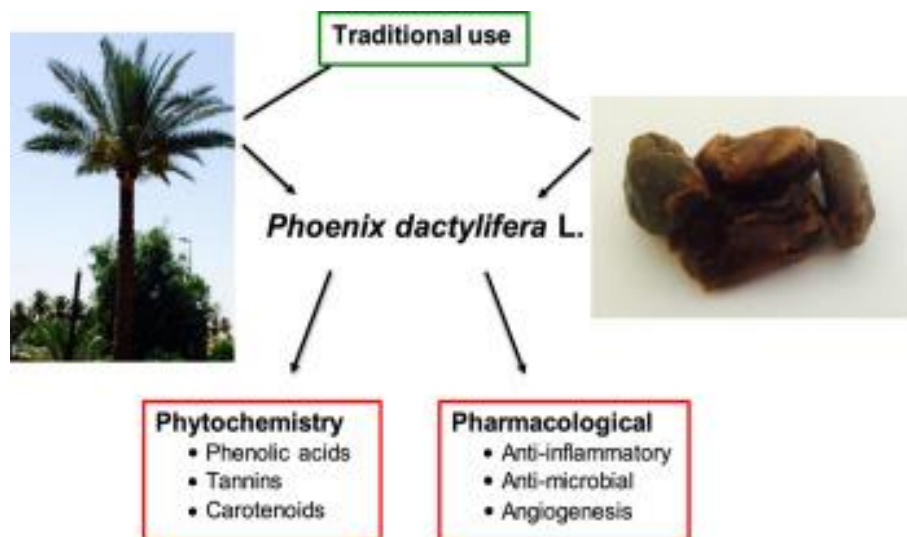
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### Abstract

Many different kinds of herbs and plants are used as food now days due to their beneficial and preventative effects on human health. Phoenix dactylifera Linn., a member of the family Arecaceae, is a widely distributed plant commonly known as the date palm. This ancient plant can be found in its native habitats of North Africa and South-West Asia. The date palm has long been revered for its symbolic and therapeutic significance. Alkaloids, tannins, glycosides, flavonoids, steroids, terpenoids, and carotenoids are only some of the active phytoconstituents found in the fruits of this plant. A multitude of pharmacological properties, including analgesic, anti-inflammatory, hepatoprotective, anticancer, antioxidant, anti-proliferative, anti-fungal, and antibacterial, have been attributed to Phoenix dactylifera in the existing body of literature. This analysis primarily focuses on the plant's nutritional value, active phytoconstituents, and pharmacological actions in order to provide a comprehensive understanding of those aspects.

**Keywords:** P. dactylifera, Phytochemistry, Pharmacological, Fruits

### Graphical Abstract



## **Introduction**

Phoenix dactylifera L., more commonly known as the date palm, is one of the most valuable domesticated fruit trees due to its ritual significance in human communities, health advantages, productive capacity, and variety of subsistence items derived from its fruits and other sections of the huge palm [1]. The date palm is one of the most valuable domesticated fruit trees due to its health advantages, productive capacity, and variety of subsistence items derived from its fruits and other sections of the huge palm. There will have been a harvest of around 9.5 million tons of date fruits all across the world by the year 2020 [2]. Dates are one of the healthiest fruits because they include a wide variety of essential elements, such as polyphenols, fiber, carotenoids, vitamins, amino acids, carbohydrates, and mineral components [3,4]. This makes dates one of the healthiest fruits. Microstructural characteristics [5], biochemical measures such as total soluble solids, phenolic content, reducing-sugar content, organic compounds, and water activity [6], and textural metrics can all be used to determine and evaluate the quality of date-fruit. In addition, deep learning as well as more traditional forms of computer vision are used in practice to evaluate the freshness, preservation, and dryness of various types of fruit.

Image analysis may be utilized to determine the linear dimensions and shape variables, in addition to the optical and textural qualities [7, 8]. Image analysis can also be utilized to determine the optical and textural properties. It is now possible, as a result of developments in non-destructive measurement techniques and rapid image processing, to extract significant picture properties for the purpose of constructing objective models for differentiating samples and evaluating object quality using machine learning [7, 9]. Significant agricultural uses can be found for it in areas such as disease diagnostics, crop quality evaluation, and variety identification [10]. A number of the elements of image analysis can be of assistance in identifying the quality of fruit. Using color features computed from photographs [11,12], it was possible to distinguish between the many varieties of date fruit, to sort and grade date fruits, and to differentiate good fruits from fruits that had been damaged or that had not yet reached maturity. Images of dates were run through a computer program that extracted data on the dates' color, texture, shape, and size in order to categorize the dates according to their level of ripeness [13]. Dates are evaluated based on their nutritional value, biological activity (nitric oxide (NO) scavenging and NO inhibition), and microbial quality (e.g., total viable count), in addition to their physical characteristics (e.g., dimensions, shape, texture, seed/weight ratios, total color changes, total soluble solids, and firmness) [14, 15]. Dates are also evaluated based on their firmness. It is possible to determine whether or not a date fruit is ripe by analyzing its physicochemical properties, which include its moisture content, size, weight, volume, tannin content, total soluble solids, and reducing sugars. On the other hand, some of the changes could not be significant enough to be picked up by the statistics [16]. It has been noted that the amount of sugar, ash, and moisture in date fruits are potentially relevant varietal features [17]. Because of their one-of-a-kind properties, date fruits can come in a wide variety of varieties, each with its own set of physicochemical factors to consider [18, 19]. Because of this, the consumption of date fruits and the processing of them can be influenced by an in-depth examination of the characteristics that a particular variety possesses. Dates have been investigated for their potential health advantages, and specific biological activity associated with date consumption have been postulated, mostly on the basis of in vitro and animal models. Among them are qualities such as anti-inflammatory [20], gastroprotective [21], and cancer-fighting [15] abilities. Dates and the

potential benefits they may have for improving vascular health need to be investigated as quickly as feasible in light of the current global epidemic of cardiovascular disease and diabetes. In this essay, we will explore the beneficial benefits that dates have on the markers of cardiovascular function in humans and how these effects are brought about by dates. Additionally proposed is date-based research for the future.

### **Taxonomical Classification**

**Kingdom:** Class Liliopsida, subclass Arecidae, order Arecales, family Areceaceae, genus Phoenix, species dactylifera[22]. Superkingdom Plantae; Division Magnoliophyta; Class Liliopsida; Subclass Arecidae.

### **Synonyms**

Arabic: Nakhleh; Croatian: Datulja; English: Date; French: Dattier; German: Daten; Greek: Phoenix; Italian: Date; Japanese: Natsumeyashi; Portuguese: Datas; Russian: Finik; Spanish: Datiler; Turkish: Hurma[22].

### **Vernacular Name**

Bengali: Khejur; Gujrati: Khajur; Hindi: Khajur; Kannada: Khajura; Malayalam: Prantapuzam; Marathi: Khajur; Odisha: Khejuri; Panjabi: Pindakhajur; Sanskrit: Kharjur; Tamil: Perichampazham; Telegu: Khajurpupandu; Urdu: Khurma [22].

### **Distribution**

*P. dactylifera* is a common garden and park plant in the Philippines. It's a common phrase in western Asia and northern Africa. It has been farmed throughout the Middle East, North Africa, and the Arabian Peninsula for centuries. *P. dactylifera* is well-known for the delicious fruit it produces, which is commonly referred to as a date. For thousands of years, the people of North Africa and the Middle East relied on this plant as their primary source of nutrition. Because of its attractive appearance and hardiness, it is also often used as an ornamental plant. This plant can tolerate a wide range of temperatures and moisture levels, making it ideal for the Mediterranean climate. The plant can thrive in a wide range of climates, from the dry heat of deserts to the humid heat of the tropics. This plant needs nothing more than unrestricted full sun to thrive. High levels of environmental humidity are associated with low fruit quality and frequent fruit drop before ripeness. There are now farms growing it in Iran, Iraq, the United States of America, Pakistan, Saudi Arabia, the United Arab Emirates, Sudan, South Sudan, Algeria, Tunisia, India, Spain, Morocco, Oman, Tanzania, Australia, and Libya [23].

### **Botanical Description**

The tree can be grown in a garden or from seed in India and reaches a height of 36-40 meters. The persistent petiole bases conceal the plant's trunks, which are typically hidden beneath a dense mat of shoots.

### **Leaves**

The leaves are linear, keeled lesser pinnae adapted into spines, pinnate 20-40 cm long.

## **Flowers**

The spadices, or clusters, of tiny flowers are branching. The blossoms have a sunny golden hue. The flower's lower half is intrinsically linked to the spikelets that will develop into fruits.

**Fruits:** The oblong berry-like fruits are known as dates. The length of the fruit is between 2.6-7.6 cm, and its width is between 2-3 cm. When mature, the fruit is a vibrant red or yellow brown, but when it's unripe, it's a dark green. Fruits' sugar content determines the kinds that can be grown.

**Seeds:** The seeds have a weird oval-cylinder form. There is only one seed, with a longitudinal slit, in each fruit. Unripe seeds typically show up as a vivid shade of red or yellow [24].

**Ecology:** Date palms can withstand high temperatures for extended periods of time, however temperatures below -8 degrees Fahrenheit are fatal to the plant. Date palms do well in dry, low-humidity climates with scarce precipitation. Dry, hot, and prolonged conditions are ideal for blossoming. Also, an average temperature of 30-35 degrees is needed for proper ripening. The date palm requires slightly alkaline soil (pH range of 5-8.2) to thrive. Date palms require a very specific type of soaking in order to flourish [25].

## **Propagation**

### **Nutrient Components**

*P. dactylifera* can reproduce both vegetatively and asexually, with the former being typically used for establishment. However, scientists are currently concentrating on organogenesis as a means of expanding this via tissue culturing. Using this method, farmers can quickly and easily grow a large number of plants from a tiny amount of meristematic tissue [26].

### **Amino Acids**

Date seeds have a varying amino acid profile depending on their ripeness. Date seeds contain a variety of essential amino acids, the most abundant of which are glutamic acid (16.44 g/100 g), phenylalanine (5.93 g/100 g), and leucine (6.10 g/100 g) [26]. In the meantime, Shina et al. (2013) used an automatic amino acid analyzer [27] to determine that aspartic acid (1.72 g/100 g), alanine (1.2 g/100 g), and tyrosine (1.2 g/100 g) are the most abundant non-essential amino acids, while leucine (1.7 g/100 g), lysine (1.1 g/100 g), and phenylalanine (1. Furthermore, non-proteogenic amino acids such as  $\gamma$ -amino-n-butyric acid and 1-aminocyclopropane-1-carboxylic acid can bind with antibodies to create T cells, remove harmful substances in the liver, and lower the body's creatinine levels. [28, 29].

### **Dietary Fibers**

The nutritional fiber content of dates is higher than that of cereals, according to research [30]. Date seeds include beneficial nutritional fibers such tannin, lignin, pectin, and hemicellulose. Date seeds have a higher fiber content than both yellow maize and barley, according to research by Attia et al. (2021) [31]. Date seeds include fiber fractions that range from 12.0% to 17.5% hemicellulose, 26.1% to 42.5% cellulose, and 7.21% to 11.0% lignin for acid detergent fiber

(cellulose + lignin), 51.6% to 75.0% for neutral detergent fiber (hemicellulose + cellulose + lignin), and so on.

### **Minerals and Vitamins**

Date seeds have been analyzed using gas chromatography and high-performance liquid chromatography (HPLC) and found to have trace amounts of vitamins A, B1, B2, C, E, K, folate, and a variety of minerals, the most abundant of which is potassium [32,33]. Additional elements and minerals include boron, calcium, cobalt, copper, iron, magnesium, phosphorus, fluorine, selenium, sodium, and zinc [34]. There are increased quantities of the minerals potassium, phosphorus, and iron. Date seeds are beneficial for persons with hypertension because of their low sodium to potassium ratio. Date seeds derived from cell culture showed greater angiotensin-converting enzyme inhibitory activity than date flesh, according to research by Hinkaew et al. (2021). Date seeds inhibited a major enzyme involved in hypertension regulation by an average of 58.69-61.36%. Date seeds' high fluorine concentration also makes them useful forwarding against cavities [35].

The seed oil of a date palm tree is loaded with vitamins and amino acids that work together to stimulate hair growth [36]. Date seed oil is rich in minerals, and those minerals have been shown to restore cell growth and energy production [37]. The United Arab Emirates (UAE) conducted experiments on 18 different types of date seed oil, such as Khalas, Lulu, Fard, Raziz, and Sokkery, with ultra-performance liquid chromatography analysis revealing significant amounts of many vitamins [38]. High levels of -tocopherol, -tocopheryl acetate, -tocopherol, and finally Vitamin K1 were discovered in the oils extracted from date seeds.

### **Sugars**

UV-visible spectrophotometry [39] found that the soluble sugars in date seeds consist of 3.5 g/kg of glucose, 3.8 g/kg of fructose, 3.7 g/kg of stachyose, 3.5 g/kg of sucrose, and 2.2 g/kg of galactose. The insulin-producing powder found in date seeds helps diabetics maintain healthy blood sugar levels [40]. Date seed extract (DSE)-insulin-treated diabetic rats showed an elevated level of serum c-peptide compared to diabetic rats treated with insulin alone [41], which El Fouhil and colleagues (2013) described as evidence of the possible hypoglycemic efficacy of date seeds. This was supported by immunohistochemical findings of compensatory beta-cell enlargement, indicating a rise in endogenous insulin secretion.

### **Fatty Acids**

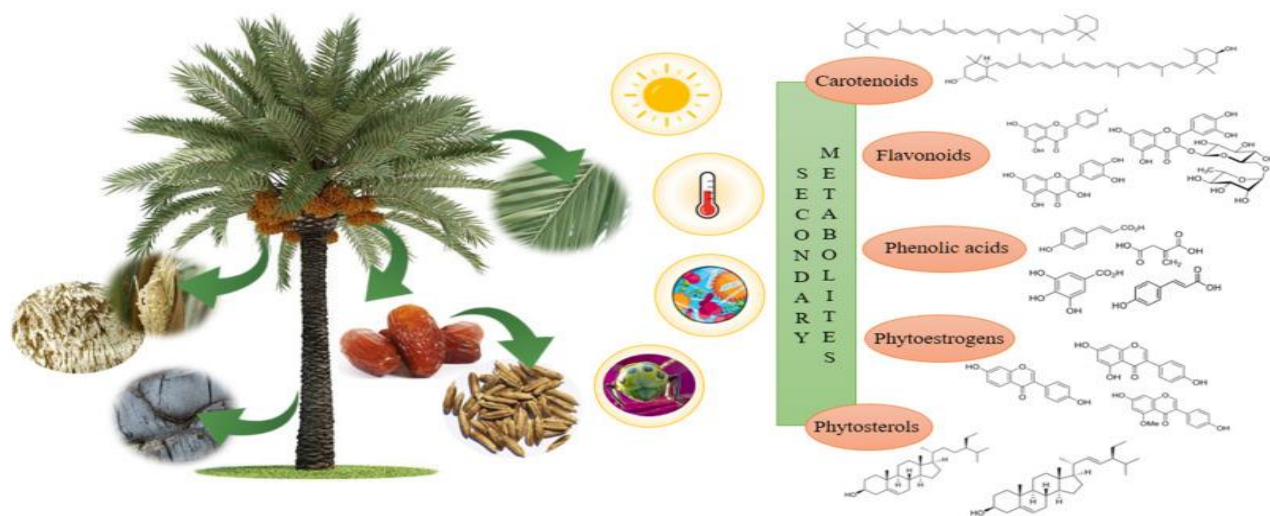
Fatty acids oleic, lauric, myristic, linoleic, and palmitic are all present in date seed oil [42]. Biglar et al. (2012) used gas chromatography to report that between 33.38% and 51.40% of oleic-lauric oil and between 18.78% and 31.61% of lauric acid were present. It was found that myristic acid, after palmitic and linoleic acids, was the third most abundant fatty acid. Date seed oil has been studied for its positive effects on poultry growth and immunity [43], and this effect was recently brought to light by Attia et al. Date seed fatty acid percentages have been recorded as follows: lauric acid 12.20%–23.06%, myristic acid 9.70%–11.30%, palmitic acid 10.11%–12.70%, stearic acid 1.56%–3.56%, oleic acid 35.1%–45.80%, linoleic acid 8.10%–11.00%, and linolenic acid 0.37%–0.80%. Except for myristic and oleic fatty acids, which were greater, these numbers were comparable to what we would expect to see in maize [44].

## Phenolic Compounds

Date seeds have been discovered to have more total polyphenols than other fruits, including grape seeds, nut seeds, and the flesh of the fruit itself [45]. Date seeds have been discovered to contain seven different phenolic acids, with the highest level detected in p-coumaric acid (varying from 109.87 to 141.72 mg/100 g) [46]. Other phenolic acids found in date seeds are caffeic acid, chlorogenic acid, ferulic acid, gallic acid, syringic acid, and vanillic acid. Data from high-performance liquid chromatography (HPLC) equipped with a diode array detector (DAD) suggests that rutin, at 71.74–86.32 mg/100 g, is the most abundant flavonoid in date seeds, followed by quercetin (23.71–34.06 mg/100 g) and luteolin (9.17–13.24 mg/100 g).

## Phytochemical Screening

Phytochemicals are compounds found in plants and may have therapeutic effects when used medicinally or consumed regularly [47]. Primary metabolites, such as nucleic acids, common amino acids, and carbohydrates (sugars), are found in all cells and play an essential role in the reproduction and metabolism of those cells; secondary metabolites, such as terpenes (a group of lipids), phenolics (derived from carbohydrates), and alkaloids (derived from amino acids), are unique to a small number of species and have a biological effect on others. Secondary metabolites include many of the biologically active components of medicinal, commercial, and toxic plants [49]. Carotenoids, polyphenols (such as phenolic acids, isoflavons, lignans, and flavonoids), tannins, and sterols are only few of the many phytochemicals found in date fruit. Date variety, fruit picking stage, storage, postharvest processing, geographical origin, and soil conditions all play a role in influencing the concentration and composition of these elements. Dates undergo substantial changes in their chemical contents and functional makeup as they mature, according to reports from a number of researchers. During this time, reducing sugars increase while fibre, minerals, and vitamins all but disappear [48].



**Fig. 1** Chemical Compound of *P. dactylifera*

## **Carotenoids**

Date fruit's lipid fractions contain carotenoids, an important family of phytonutrients. They help prevent damage to cells caused by free radicals and are necessary for the production of vitamin A, an essential nutrient for healthy vision [50]. Carotenoids can be broken down into two distinct groups—xanthophylls (which contain oxygen atoms) and carotenes (which lack oxygen atoms)—based on whether or not they have oxygen in their molecules. Dates include lutein and -carotene as significant carotenoids, as determined by research conducted by Boudries et al. on the carotenoid makeup of three different types at three edible maturation stages (Khalal, Rutab, and Tamr). Dates included trace amounts of the carotenoid xanthophylls neoxanthin, violaxanthin, and antheraxanthin, the yellow-colored Khalas naturally contains the highest concentration of these antioxidants. Sun drying date fruit resulted in a loss of between 4 and 30 percent of total carotenoids, according to the study (Al-Farsi et al., 2005a). When compared to other dried fruits like figs (0.032 mg/100 g) and apricots (2.20 mg/100 g), dried date fruit provides a modest source of carotenoid (0.97 mg/100 g) [51].

## **Phenolic acids**

Phenolic acids have a hydroxyl function on an aromatic benzene ring and one or more carboxylic acid groups, making them one of the most important aromatic secondary plant metabolites. There are two major categories of phenolic acids, the seven-carbon-atom derivatives of benzoic acid and the nine-carbon-atom derivatives of cinnamic acid [52]. They are powerful antioxidants because they can neutralise harmful free radicals. Several studies have found that dates have a high concentration. In their analysis of three varieties of Omani dates (Fard, Khasab, and Khalas), Al Farsi et al. found the following derivatives of cinnamic acid: o-coumaric acid, p-coumaric acid, caffeic acid, and ferulic acid; and of benzoic acid: p-hydroxybenzoic acid, protocatechuic acid, vanillic acid, gallic acid, and syringic acid [53]. conducted a study on seven distinct types of date fruits grown in Algeria, and they found that p-coumaric acid, ferulic acid, and sinapic acid were the primary phenolic acids present. In addition, xanthoxylin acid, hydrocaffeic acid, and coumaroylquinic acid were described, as well as the three isomers of 5-o-caffeoyl shikimic acid [54]. By comparing the retention time and UV spectrum of the peaks of these compounds with those of standard phenolic acids, Karasawa et al. identified protocatechuic acid, syringic acid, caffeic acid, ferulic acid, and chlorogenic acid in the date extract using UPLC According to a 2015 study ferulic acid, p-coumaric acid, and gallic acid were the most abundant phenolic acids among Saudi date fruit varieties. The phenolic makeup of the Amari and Hallawi date types at the Tamr stage was recently investigated high-performance liquid chromatography (RP-HPLC) was used to analyse the phenolic fractions by comparing their retention durations of chromatogram peaks to a library of authentic related reference chemicals based on their UV/Vis absorbance spectra. The software was used to determine the concentration of each phenolic compound by comparing the area under the curve of the peak on the chromatogram to known concentrations of caffeic acid, coumaric acid, ferulic acid, salicylic acid, and kaempferol-3-glucoside in triplicate. They found that Hallawi has five phenolic acids and Amari had seven. For both types, ferulic acid was the most abundant phenolic acid, while coumaric acid was present only in minute amounts [55].[56].Salicylic acid was discovered to be the most prevalent phenolic acid in Hallawi, while caffeic acid derivatives dominated in Amari[57]. Three different types of

Tunisian date fruits tested positive for the presence of protocatechuic acid, vanillic acid, gallic acid, syringic acid, and p-coumaric acid [57]. According to research by Lemine et al., the phenolic acid content of dates in the Khalal stage is 0.729% g/100 g (wt/wt) while that of dates in the completely mature Tamer stage is 0.559 g/100 g. .

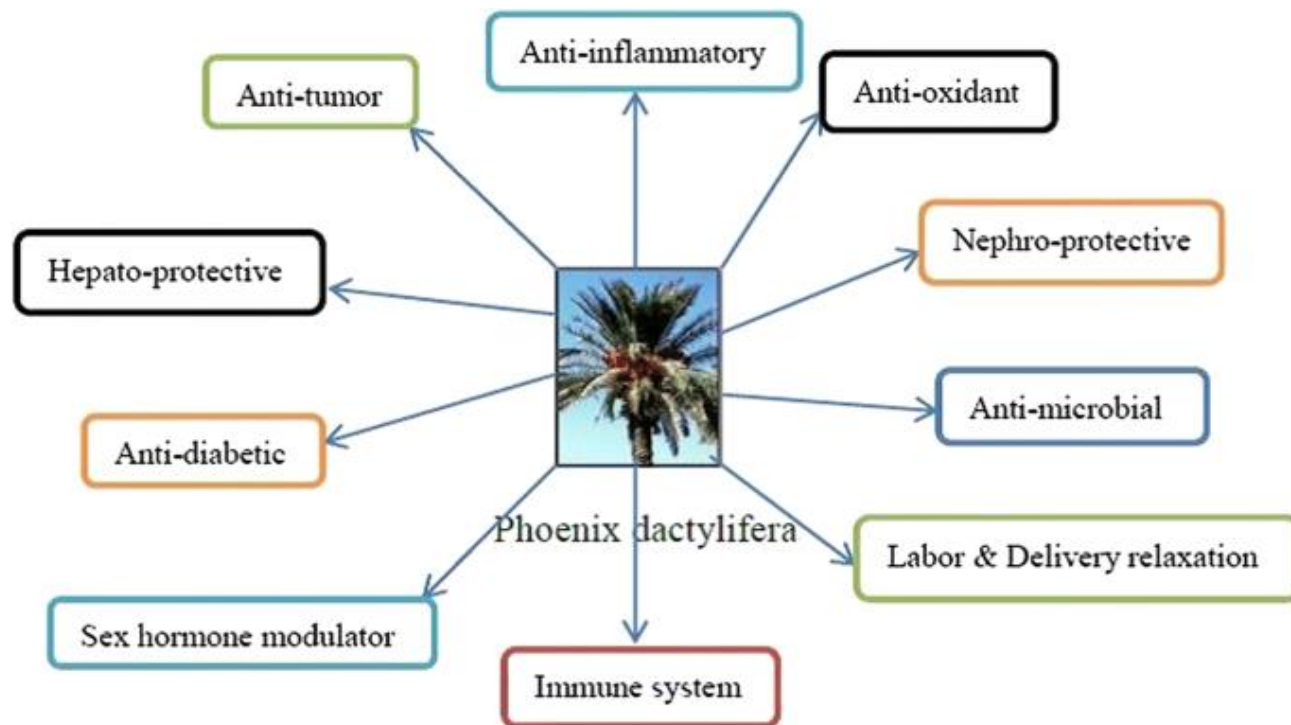
## **Flavonoids**

Formed from a 15-carbon skeleton consisting of two aromatic benzene rings A and C chemically bound via a heterocyclic pyrane ring C, flavonoids are a diverse family of polyphenolic plant-derived secondary metabolites[58]. Anthocyanidins, flavones, flavonols, flavanones, flavanoneol, isoflavones, and flavan-3-ols are just few of the subsets of flavonoids. Many fruits and vegetables include flavonoids, which have anti-inflammatory and antioxidant properties (Moss and Ramji, 2016). In addition to reporting flavonoid sulphates, Hong et al. (2006) used liquid chromatography-electrospray ionization/tandem mass spectrometry (LCESI/MS/MS) to analyse the flavonoid glycoside and procyanidin compositions of date fruit, variety Deglet Noor, harvested at the Khalal stage of maturity. According to research conducted [59] [60] on 10 different types of Tunisian dates, the Korkobbi variety exhibited the highest antiradical efficacy since it contained the highest levels of flavonoids. Dates of the Fardh, Khasab, and Khalas types were studied for their total flavonoid content in Oman during the Rutab and Tamr stages of edible maturity shows the isolation of two novel diosmetin glycosides, diosmetin 7-O--L-arabinofuranosy (12)--D-apiofuranoside (Diosmetin 1) and diosmetin 7-O--D-apiofuranoside (Diosmetin 2)[61].

It has been estimated, that 62% of all modern drugs are of natural products origin, of which (14%) are mimic of natural product or containing natural product pharmacophore [62]. The rest 38% of current drugs are either purely synthesized (27%) or synthesized to mimic a natural product (11%) [63]. Thereby documenting that natural product compounds have been a successful drug source for the pharmaceutical industry. Moreover, world-health organization reported that ca. 80% of the world's populations depend on conventional medicine for their primary health care. Natural products extracted from the fruits of date palm tree has been shown to possess many health promoting properties such as anti-inflammatory, anti-fungal, anti-oxidant and anti-tumor effects[64].



### Pharmacological activity



**Fig: 2** Pharmacological Activity of Phoenix dactylifera

**Antibacterial Activity:** Exploring the antibacterial activities of date pits, several authors also reported the presence of polyphenols, alkaloids, flavonoids, tannins, and steroids that work towards the combined action as antioxidants. These secondary metabolites can serve as potent natural products and phytochemicals and significantly retard the microbial growth, proliferation and infection [65]. These compounds may act individually as a biologically active compound or provide a synergistic effect to achieve antibacterial properties [66]. Similarly, in another study, the methanolic extract of Ajwa had antibacterial activity against *E. coli*, *Bacillus cereus*, *S. aureus*, and *Serratia marcescens* [67]. The antibacterial, antifungal and anti-viral activity of extracts obtained from medicinal plants normally depends upon organic solvent, target organism, and plant parts used. Shakiba et al. reported that among all the pits extract tested, the MeOH: CFM extract was more potent at inhibiting the microbial activity. There was no inhibition zone observed for *E. coli* (PTCC 1270), *E. coli* (PTCC 1399), and *S. marcescens* for the methanol extract of Mazafati. However, the same extract inhibited the *E. coli* (PTCC 1330) [68]. This shows that the antibacterial properties of the methanolic extract of the same date palm variety could also possibly be selective against certain strains of bacteria [69] [70] reported that date pit aqueous extract treated with silver nanoparticles (AgNPs) decreased the *Rhizoctonia solani* (AG2\_2) population at 25  $\mu\text{g/mL}$  while it also significantly reduced the *Klebsiella pneumonia* (PCI 602), and *Acinetobacter baumannii* (ATCC 19606). In another study, the acetone and methanol extracts of three date pits showed antibacterial activity against *Bacillus subtilis*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Shigella flexeneri*, *Staphylococcus aureus*,

and *Streptococcus pyogenes*. However, aqueous extract had poor phytotoxic impact against all tested microbial pathogens and a negligible effect on *P. aeruginosa*. Meanwhile, pits extracts were found to be more effective than leaf extracts [71]. Earlier, it was reported that methanol and acetone extracts of the *P. dactylifera* pits moderately inhibited the growth of Gram-positive and Gram-negative bacteria [72]. Another study conducted in Iran on four different date pits demonstrated that all pit extracts showed inhibitory effect against *Staphylococcus aureus*, but not against *Escherichia coli*. Minimum inhibitory concentration and minimum bactericidal concentration of the extracts ranged from 1.56–3.125 and 3.125–12.5 mg mL<sup>-1</sup> for *Staphylococcus aureus*, respectively [46]. It was reported that the phytotoxicity of date pits is mainly due to the presence of secondary metabolites such as cinnamic acids, flavonoid glycosides and flavanols [73, 74, 75].

### **Anti-ulcer activity**

Studied the *P. dactylifera* possesses the antiulcer activity. The chloroform extract of date palm leaves had shown antiulcer activity at the dose level of 200 and 400 mg/kg and the higher dose showed the potent antiulcer activity as compared with standard drug [76]

### **Anti-diabetic activity**

Studied *P. dactylifera* fruit extract used to treat alloxan induced diabetes in rats. From this studied it was concluded that the antidiabetic activity has been shown due to the presence of active phytoconstituents i.e. flavonoid [77].

### **Anti-cancer activity**

Evaluated that glucagon has isolated from Libyan dates and from this studied it concluded that the purified form of glucagon shows potent anticancer activity [78].

### **Nephroprotective activity**

Investigated that *P. dactylifera* had a potent nephroprotective potential. The flesh and pits extract of plant give potent nephroprotective activity against gentamicin induced nephrotoxicity. Thouri *et al.*[79] from the studies concluded that the dichloroacetic acid induced nephrotoxicity in wister rats were cured with 4 ml/kg dose level through the inhibition of Malondialdehyde (MDA) and Glutathione (GSH) levels. It was further also concluded that the plant also has the antioxidant potential [80]

### **Anti-inflammatory activity**

Studied Ajwa variety of dates for anti-inflammatory activity. Methanolic, ethyl acetate and water extract were used in this studied. From this studied it was concluded that the plant has significant anti-inflammatory activity and also inhibited the Lipid Peroxidation (LPO). Mohamed *et al.*[81] also studied that methanolic extract of *P. dactylifera* fruit can be used for reducing the swelling of foot. And from this study it showed that the methanolic extract has

significant anti-inflammatory potential. Eddine *et al.*[82] investigated that the leaves extract of dates has showed the potent anti-inflammatory as well as antioxidant potential.

### **Sedative activity**

Reported that hydro-alcoholic extract of *P. dactylifera* has shown the sedative effect. In this study Electroencephalography (EEG) result showed that a dose level of 125 and 250 mg/kg were appropriate for maintaining the low and high frequency waves [83]

### **Treatment for delivery and labor relaxation:**

Studied that *P. dactylifera* fruits can used safely during pregnancy. From the study it was seen that the date fruits significantly increased labor and dialated the cervical portion during pregnancy in women [84]

### **Treatment for alzheimer disease**

Investigated that the leaves extract of *P. dactylifera* prevented the chemically induced memory loss using scopolamine and streptozotocin in mice at a dose level of 100, 200 and 400 mg/kg. The plant extract also has the antioxidant and neuro-protective activity. From this study it was concluded that the fruits have the potential activity to manage the Alzheimer disease [85]

### **Treatment for fertility and development of reproductive activity**

Studied *P. dactylifera* for the purpose of male infertility as in traditional medication. The animals were treated with *P. dactylifera* pollen at dose level of 100 and 200 mg/kg. The several parameters showed that date palm pollen were effective in case of fertility and developed the reproductive system. From this it was concluded that the plant has significant effect in fertility and in reproductive system. Khalifa *et al.* [86] investigated the aqueous extract of *P. dactylifera* and found increase in the sperm quality and control in the oxidative level. Therefore, in this study aqueous extract of *P. dactylifera*, dose level of 10 and 20 ml/kg was used. Both dose levels increased the sperm quality by decreasing the abnormal sperm and increasing the number of living cell.

### **Treatment against cryptosporidiosis:**

Investigated cryptosporidium infection that is dangerous and results in immunodeficient hosts. There is no appropriate medication for this disease. Therefore, the aqueous extract of *P. dactylifera* had been used against immunosuppressed mice. After checking all the immunological parameter it concluded that it showed significant results after use of *P. dactylifera* [87]

### **Future Prospectives**

Utilising the phytochemical qualities of industrial fruit or herb wastes in animal feeding has recently been popular, since it not only improves animal productivity and health but also lessens the impact on the environment [88, 89]. Similarly, research into and attempts to improve the

phytochemical or nutraceutical prosperity of date pit or waste via solid state breakdown by *Trichoderma reesei* L. and their utilisation in animal feeds have been published [90,91]. The antioxidant activity, phenolic (142 g gallic equivalent/kg) and flavonoid (117 g rutin equivalent/kg) contents, and mannan oligosaccharide content of degraded date pits were all reported to be improved by solid state degradation with *T. reesei* by Alyileili et al. [92]. Degraded date pits may have positive effects on gut health and barrier function due to the presence of probiotic, phenolics, and flavonoids, as well as significant antioxidant activity [93]. As a result, researchers in the field of poultry nutrition investigated the potential supplemental benefits of *T. reesei*-mediated solid state degraded date pit [94, 95]. Degraded date pits (10% of the diet) increased catalase, superoxide dismutase, and glutathione peroxidase activities in the serum, liver, and intestine, and decreased malondialdehyde content in grill chickens compared to the control group [96]. The crypt depth in the intestine was likewise reduced, but villus length and villus/crypt ratio were both raised [97]. Poultry fed 10% decomposed date pits had lower numbers of harmful bacteria including *Escherichia coli*, *Enterobacteriaceae*, *Salmonella*, and *Shigella*, and higher numbers of good bacteria like *Bifidobacterium* and *Lactobacillus* [98]. Chickens fed degraded date pits also had an increase in the gene expressions of mucin-2, cathelicidin-1, beta defensins, and liver expressed antimicrobial peptide-2 in the jejunum (which inhibits the attachment of invading pathogens to intestinal epithelia) [99]. There was no difference between 10% damaged date pits and the control in terms of body weight, feed intake, or feed conversion ratio [100]. Chickens were fed either non-deteriorated (5%) or degraded (10%) date pits by Alyileili et al. [101]. Degraded date pit diets were more effective than non-degraded date pit diets at lowering *E. coli*, *Salmonella*, *Campylobacter*, and *Shigella* spp. populations compared to the control diet. While feed conversion ratios were greater on diets containing non-degraded date pits compared to the control and degraded date pit diets, body weight gains were unaffected. With 5% and 10% deteriorated date pits, European production efficiency index was higher than with non-degraded date pits and the control [102]. Overall, the results suggested that date pits can improve gut health by decreasing pathogenic bacteria and increasing beneficial bacteria, as well as by increasing the gene expression of antimicrobial peptides in the jejunum and the concentrations of immunoglobulins in the intestine and serum. Due to the presence of plant bioactive principles (such as phenolics and flavonoids) in non-degraded or degraded date pits, the gut barrier and electrophysiological functions, such as mRNA expressions of tight junction proteins, permeability, may be investigated in the future, especially during pathogenic microbial challenge models[103][104]

Animals, poultry, and fish are currently being fed date by-products. They are thought to be beneficial to human health as prebiotics [105] because of the high levels of total fibre they contain. Date seed/kernel dietary fibre concentrate showed promise as a new source of prebiotic feed additives, with the potential to boost populations of the probiotic *Lactobacillus paracasei* [106]. Enzymatic hydrolysis of date fruit fibre concentrate yielded a new product high in antioxidant soluble fibre [107]. Date kernels have been reported to be a novel source of functional products with interesting technological functionalities due to their high content of dietary fibre [108,109]. This is based on the nutritional values and chemical composition of the protein, carbohydrate, fat, and mineral content in the date kernels. The foregoing will increase the worth of date by-products, fruits, seeds, etc., as inexpensive natural diet sources with potential as bioactive and nutritive additives in the pharmaceutical and food industries[110].

## Conclusion

Date consumption may improve indicators of vascular health, according to emerging studies. Animal studies showing positive results in response to the whole fruit or extracts provide excellent justification for human clinical trials and epidemiological studies. Date consumption, or at least the polyphenol part of date consumption, appears to positively alter plasma lipid levels, oxidative stress indicators, and inflammatory markers, all of which are responses linked with enhanced cardiovascular health. Assessment of functional markers would provide valuable information in addition to evaluating changes in cholesterol or markers of oxidant defence. Date seeds are a potential weapon in the fight against nutritional deficiencies, infections, and oxidative stress-related diseases and disorders. Recent pharmacological research has shown that DSEs have multiple biological actions that affect human health. To fully understand polyphenols and other unusual bioactive chemicals, such as their mechanism and safe dosage range, more research is needed. Research into the use of date seeds as a treatment for chronic diseases holds tremendous promise and potential. Dates and polyphenols generated from dates have been shown to have beneficial effects on health, and it would be useful to conduct clinical trials that capture the link between circulating metabolites and physiological responses. Dates may be a great food to assist achieve your nutritional objectives, especially if your current recommendations for a diet rich in plant foods.

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